Object Oriented Programming

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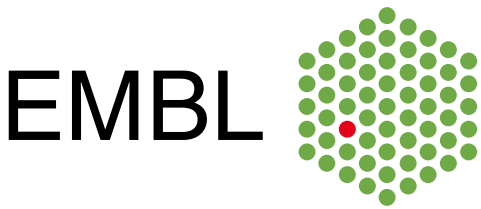

Procedural Programming

Procedural programming: organising programs around functions.
Object-oriented programming: organising programs around objects.

Object Oriented Programming

OOP

Aggregation organise functions & data into classes.

Encapsulation hide information inside methods.

Polymorphism re-use code for multiple types.

Inheritance re-use code from one class to build another.

User-Defined Types

Built-in Types

1. lists
2. dictionaries
3. strings
4. ...

Type

What's a Type

1. A domain of values
2. A set of methods (functions)

Examples of Types

List

1. Domain: lists
2. Functions: L.append(e),L.insert(idx,e), ...
3. Operators: L[0], 'Rita' in L

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List

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Integer

1. Domain: $\ldots, -2, 1, 0, 1, 2, \ldots$
2. Operators: A + B,...

User-defined Types

Object-oriented programming languages allow us to define new types.

Motivating Example

Simple Simulation

1. Boat goes around the ocean
2. You can move it around

Boat Class

We define a Boat class, with two values, latitude & longitude, and five methods:

1. move_north, move_south, move_east, move_west
2. distance

Using our Boat

```
b = Boat()
b2 = Boat()
b.move_north(1.)
b2.move_south(2.)
print b.distance(b2)
```

Classes As Logical Units

Class

A class aggregates data and functions that belong together.

Boat Interface

Interface

Functions:

1. Constructor: Takes the initial adaptation value and sigma.
2. move_*: Moves the boat.
3. distance(b): Computes the distance between two boats.

Data elements:

1. latitude: Current latitude.
2. longitude: Current longitude.

Calling Methods

Defining a method

```
class Boat(object):
    def __init__(self, lat=0, long=0):
        self.latitude = lat
        self.longitude = long

    def move_north(self, dlat):
        self.latitude += dlat
```

Calling a Method

```
obj = Boat()

obj.method(arg1,arg2)
```

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Polymorphism

Type Polymorphism

Code is polymorphic if it can use different types without change

Scientific Boats

- A scientific boat can take samples as well as travel

ScientificBoat

```
class ScientificBoat(object):
    def __init__(self, lat=0, long=0):
        self.latitude = lat
        self.longitude = long

    def move_north(self, dlat):
        ...
```

Duck Typing

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Typical Polymorphism

Typical examples

- Actors in a simulation.
- File-like objects.
- Widgets.
- ...

Inheritance

The code for ScientificBoat is very similar to the code for Boat.

```
class ScientificBoat(Boat):
    '''
    A type of Boat, which can take samples
    '''
    '''
    def sample(self):
        ''' ... '''
```

Lyskov Substitution Principle

If D inherits from C, then
you should be able to use D anywhere you previously used C.

Behaves-Like

If D inherits from C, then
D should behave-like C.

New-Style vs. Old-Style Classes

```
class Boat(object):
    ...
```

Are we inheriting from object?

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